Strong Cu-O hybridization in cuprate superconductors evidenced by NQR

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The electric-field-gradient analysis of measured NMR/NQR data and resonant Raman scattering by Raman-active collective modes are powerfull tools which allow to study, respectively, the static quadrupole moment of the intracell electronic charge distribution and the corresponding quadrupole charge transfer fluctuations. Angle-resolved-photoemission spectroscopy (ARPES) represents another probe, additional to NQR, which reveals the static occupation of the copper and oxygen sites.

We first discuss experimental results regarding resonant Raman signals in the underdoped and insulating AFM cuprates, associated with the fluctuating stripes, the two-magnon excitations and the intracell oxygen-oxygen charge transfer fluctuations, to achieve the qualitative understanding of the static intracell charge distribution between one copper and two oxygen sites revealed by the NMR/NQR experiments. The possibility to measure signals in NMR/NQR experiments associated with the static oxygen-oxygen charge transfer is briefly discussed in this context. The intracell charge distribution in $La_{2-x}Sr_xCuO_4$, described in terms of the average hole number on copper sites n_d, is estimated from the measured $^{63}\nu_Q$ frequencies. n_d and the slope $\partial n_d/\partial\delta$ are also calculated using the Emery three-band model for both $U_d \to \infty$ and $U_d = 0$ and for the single-particle parameters extracted from ARPES experiments. The large difference between two sets of estimated values for n_d and $\partial n_d/\partial\delta$ is discussed in terms of the large U_d limit of the three-band model. It appears that, through the coupling with CDW and charge transfer fluctuations, the spin density fluctuations strongly affect those and other properties of cuprates.